The Present Position of Spinal Analgesia,

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GEORGE HERBERT USSHER,

M.B., CH.B. (EDIN).

Resident Medical Officer—The General Infirmary, Burton-on-Trent.

Late Resident—The Coombe Hospital, Dublin.

„ „ The Royal Infirmary, Hull.

„ „ The Gordon Hospital, London.

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SPINAL ANALGESIA.

Introduction:

In my final year at Edinburgh, 1904, I had the pleasure of hearing Mr. Caird's introductory lecture on Surgery, in which he briefly outlined the recent advances made in the field of Local Analgesia, which had paved the way for the introduction of a still more wonderful development, viz: Spinal Analgesia.

So impressed was I by the remarkable accounts of the operations which Mr. Caird had recently seen performed under Spinal Analgesia, by Bier in Germany, that I determined, should the occasion arise to give the method a trial. It was not however until more than a year later towards the end of 1905, that while Resident at the Hull Royal Infirmary, I had, with the kind permission of the Senior Surgeon, the opportunity afforded me of inducing my first Spinal Analgesia.

Since that date up to the present time I have employed the method in a fair number of cases with varying success, and the results of my experience of the method in Modern Surgical Practice, have afforded me the scope of this Thesis.

Although not yet out of the experimental stage, it has fully established itself as an alternative to General Anaesthesia, and in certain cases, I can unhesitatingly say, its superiority; and lives which would undoubtedly have been lost under a General Anaesthetic, have been saved by its means.

But as in the introduction of all important Surgical procedures, the evolution has been slow.

One authority gives a glowing account of the virtues Spinal Analgesia whereas another points out only the dark side of the picture, inducing the medical man whose experience of the method is limited to the Literature only, to look upon it with fear and trepidation.

Thus it happens that although as far back as August 1898, Spinal Analgesia was employed by Bier in the performance of surgical operations; the method was not adopted in this country until several years later. In the first instance, when Cocaine was employed, the disagreeable sequelae that followed the injection in many cases rendered the general adoption of Spinal Analgesia undesirable. But since the discovery by Fourneau of Stovaine the method has been extensively adopted and few surgical developments of recent years have provided us with such a powerful weapon to combat the perils of general anaesthesia in certain grave cases.

Where the surgeon is likely to have doubts as to the safety of his patient under general anaesthesia, during the operation, or to his welfare after it, the field is open for Spinal Analgesia; and in the near future there is no doubt but that the method will be more extensively practised. Even now, where the choice lies between a general anaesthetic at the hands of an inexperienced man, and Spinal Analgesia in the hands of an expert, it would undoubtedly be wise to choose in favour of the latter.

But, when it is a question of choice between the two methods at the hands of an expert, in most cases, the advantage would probably lie with the older method. For although the general results of Spinal Analgesia are exceedingly good, it has still not reached that stage of perfection as to be absolutely reliable in every case, and as long as this fear of uncertainty exists, it will be a serious obstacle to its advancement. Even men experienced in the method have to recount a number of failures, which if occurring in anything like the same proportion in the administration of chloroform or ether by an Anaesthetist, would stamp him as incompetent. Whether, however, with further insight into the method the failures will be eradicated, it is rather premature to say, but if they can only be finally overcome, Spinal Anaesthesia will obtain a sound footing. At present the opinion as to its general adoption is still "sub judice" and further investigation of its merits and demerits is necessary.

But it must not, however, be too severely condemned on account of certain of its earlier misfortunes, for had the first mischances of chloroform led to its being discarded, of what a blessing would humanity have been deprived! While admitting that several mishaps have occurred with this new method, to its credit are due many lives, lives that would, under a general anaesthetic, have undoubtedly been lost. It is especially in cases where great shock is anticipated that Spinal Analgesia has proved of inestimable value whilst in combating the paralytic condition of the intestine in some cases of peritonitis, its

effect has been marvellous.

The more I see of the method, the more I like it, and I feel convinced that ere many years have elapsed, Spinal Analgesia will have obtained a strong foothold in the practice of modern surgery.

In the present thesis I have given a short historical outline of Spinal Analgesia, the methods in vogue at the present day, the various drugs employed &c. and finally I have added a list of cases in which I have either personally produced Spinal Analgesia or assisted in doing so.

2. Historical outline.

In looking into the history of Spinal Analgesia one finds that the first person to try the method was J. L. Corning. In the New York Medical Journal, October 31st 1885, he published a paper entitled "Spinal Anaesthesia and Local Medication of the Cord."

The drug he used for his experiments was Cocaine Hydrochloride which he injected into the Spinal canal between the spinous processes of the lower dorsal vertebrae with the idea "of producing artificially a temporary condition of things analagous in its physiological consequences to the effects observed in transverse myelitis or after total section of the cord." The following experiment was performed on a dog.

20 minims of a 20% solution of Cocaine Hydrochloride were injected into the space situated between the spinous processes of the two inferior dorsal vertebrae.

5 minutes after the injection there were evidences of incoordination in the posterior extremities. A few minutes later there was marked evidence of weakness in the hind legs whereas the forelegs remained normal.

Sensibility was tested by means of a powerful faradic current. When applied to the hind limbs there was no response or sensation but when applied to the forelegs the animal howled.

From this experiment Corning inferred that the action of the aneasthetic was practically local, being confined for the most part to that portion of the cord, situated immediately beneath

the point of injection.

A second experiment was performed on man, 30 minims of a 3% solution of Cocaine Hydrochloride were injected into the space situated between the spinous processes of the 11th and 12th dorsal vertebrae. After the lapse of 8 minutes as there was no evidence of impaired sensibility, a second dose of 30 minims was injected in the same way.

About 10 minutes later the patient complained that his legs felt sleepy and on examination the sensibility was found to be greatly impaired. 15 to 20 minutes later the aneasthesia had increased in intensity and was principally limited to the lower extremities, the lumbar region, the penis and scrotum.

The power of distinguishing differences in pressure seemed to be preserved. Sensibility to temperature was not tested. The passage of a sound usually accompanied by considerable pain was this time unperceived. When the patient left an hour or more after the injections sensibility was still impaired to a marked degree. The patellar tendon reflexes were abolished.

Dr. Corning adds, that, applied in this manner, Cocaine should be of service in Strychnine poisoning, hydrophobia and tetanus, but makes no mention of the use of the method as an anaesthetic for the performance of surgical operations.

Nothing more was heard of the method for 13 years when in August 1898, Dr. August Bier utilised it for the actual performance of an operation. The first case was a man, aged 34, suffering from many tuberculous lesions for which amputation at the ankle joint was performed. The patient lay on his side,

and an ordinary lumbar puncture, according to Quincke was made. Then to the needle was attached a Pravaz syringe and 3 c.c. of a 0.5% cocaine solution were injected.

After 20 minutes sensation was abolished in the lower extremities and the operation was performed without pain. A slight acceleration of the pulse rate was noticed.

4 days later the method was again employed, this time on a youth of 17 years of age, suffering from old osteomyelitis of the Tibia. In this case ½ c.c. of a 1% solution was injected. 5 minutes later the sensation of pain was abolished and the operation was painlessly performed.

After six successful operations under spinal cocainisation, on August 24th 1898, Prof. Bier heroically offered to undergo the injection himself in order to accurately observe and record the sensations experienced under its influence. ½ c.c. of a 1% cocaine solution was employed but, unfortunately owing to a technical flaw in the administration, some of the cocaine solution was washed away by the cerebro-spinal fluid and consequently the experiment was a failure.

The injection was then performed by Prof. Bier on his assistant, Dr. Hildebrandt, using the same amount and strength of solution.

This time the experiment was successful and the following is a record of the tests applied during the analgesia.

Pulse 75.

After 7	minutes	Needle pricks in thigh felt as touches.
" 8	"	A small skin incision in thigh felt as pressure. Deep puncture with a needle felt as pressure.
" 10	"	A larger steel needle inserted into the flesh until it reached the bone produced no pain.
" 11	"	Sensation of pain diminished in upper limbs.
" 13	"	Burning cigar applied to leg produced a feeling of warmth, but no pain. Ether produced a feeling of cold.
" 23	"	Hard blows with a hammer on skin, not painful.
" 45	"	Sensation of pain began to return. Pulse did not go up above 75.

The next morning Dr. Hildebrandt suffered from a violent headache and felt ill. He however gradually recovered but felt the effects for 8 - 9 days. Thus it is to the careful observations of Bier and his assistant that we owe the true position of cocaine as a Spinal Analgesic. Their conclusion was that so long as cocaine was the only drug available, the disagreeable sequelae seen in some cases would prevent the general adoption of spinal analgesia.

In France Tuffier was the first exponent of Spinal Analgesia. In November 1899 he relates a case where he used this method to relieve the pain of a recurrent pelvic osteosarcoma in a young man. Following on this he used the method in several cases of operation on the lower extremities.

In a woman of 40 he removed a large sarooma of the right thigh. Anaesthesia was complete in the lower limbs in 3 minutes, and had extended up to the umbilicus in 6 minutes. The operation was commenced 8 minutes after the injection. Sensibility began to return after one hour.

A vaginal Hysterectomy was also performed by this method with perfect Analgesia, and also two other operations on the lower extremities.

According to Tuffier the method was to be used with great caution, as even a dose of 0.02 centigramme of cocaine in 1 or 2 c.c. of water, had led in some cases to vomiting and persistent headache.

At the International Medical Congress, Paris 1900, Tuffier made some further remarks on the subject of Spinal Analgesia. He stated that since November 1899 he had made numerous experiments on the method and had been able to induce Surgical Anaesthesia by the injection of solutions of Cocaine into the lumbar subarachnoid space. He had performed operations on the lower extremities, perineum, rectum, abdomen, external and internal genitalia, 63 cases in all, and had not failed to produce complete anaesthesia

in any of them. Neither were there any early or late after effects of any serious import. He did not operate by this method above the diaphragm.

At this Congress he demonstrated the method to English, German and American Surgeons, performing several major operations, including an abdominal Hysterectomy and a nephrectomy, with complete success.

Murphy, of America, was amongst those present and he describes Tuffier's methods in the journal of the American Medical Association, September 1st 1900. He was probably the first in America to use the method for producing Surgical Anaesthesia and in the same journal he described 3 cases in which Anaesthesia was successfully induced in this way.

Regarding its history in England, the first mention of the subject appeared in the Medical Annual of 1901, but not until 1904 was the method used by an English surgeon. In that year Dr. A. W. Lea of Manchester performed several operations, most of them abdominal, under Spinal Cocainisation, and in the majority of cases the Analgesia was adequate. He believed that the chief risks were the toxic effects of the cocaine and the danger of sepsis as cocaine solutions could not be boiled.

The method however was not taken up at that time in England as the dangers were considered too great. Even foreign workers who had by this time an extensive experience of Spinal Cocainisation declared that the method had been adopted at first with too much enthusiasm, and although

an efficient analgesia could be obtained by Cocaine, the question arose, whether the method was justifiable. As long as cocaine alone was employed it was seen that the method would never be generally employed. Then it was suggested that adrenalin should be employed along with the cocaine in order to counteract its dangers, but although this produced a longer analgesia, still the disagreeable after effects remained. It was quite possible at this time that the method would have fallen into disuse had not the discovery of 'Stovaine' by Fourneau given a fresh impetus to its employment. It was eagerly employed abroad and found so satisfactory that the method was again undertaken in England, this time to a considerable extent. Caird and Chiene of Edinburgh, and A. E. Barker of London, were amongst the first in this country to study the matter seriously. Since that time, 1905, numerous other workers have entered the field with the result that the method is becoming firmly established throughout the country. To Barker we owe many valuable contributions to the literature of the subject and to his careful researches is due the technique employed in England. No one has done more than he in endeavouring to estimate the real value of Spinal Analgesia, but as yet he has not given a definite opinion as to its future.

3. Turning now to the various drugs used for Spinal Analgesia and their relative merits we find now-a-days several which are commonly employed. Although theoretically one may be better than another it will be only after an extensive experience of their practical use that one will be able to say definitely which ones should or should not be employed.

Of the local anaesthetics in use we have:

1. Cocaine.
2. Beta-Eucaine.
3. Beta-Eucaine Lactate.
4. Stovaine.
5. Novocaine.
6. Tropacocaine.
7. Alypin.
8. Nirvanine.
9. Holocaine Hydrochloride.
10. Acoine.
11. Orthoform.
12. Anaesthesine.

To be of practical importance they should conform to Braun's postulates, viz:-

1. They should possess a lower degree of Toxicity than cocaine in proportion to its anaesthetic power.
2. They should be sufficiently soluble in water. The solutions should be stable and should be capable of sterilization by boiling.

3. They should not cause any irritation. There should be no injury to the tissues; the local anaesthesia should be easily absorbed without causing any after effects, such as Hyperaemia, inflammation, infiltrations or necroses.
4. They should be compatible with adrenalin.
5. They should rapidly penetrate the mucous membrane and be suitable for Medullary Anaesthesia.

If a drug can be obtained which fulfils these conditions it can be safely said that it will supersede Cocaine. For subcutaneous and intraspinal injections, solubility is essential and of the above list Acoine, Holocaine Hydrochloride, Anaesthesine, Orthoform and Beta-eucaine are all more or less insoluble and hence unsuitable for Spinal Anaesthesia. Cocaine, Stovaine, Novocaine, Tropacocaine, Beta-eucaine Lactate, Alypin and Nirvanine are all freely soluble in water and stable.

Cocaine cannot be boiled but the others can be sterilized at 115° C. undergoing no change.

As to anaesthetic properties, Stovaine has, weight for weight, a much more powerful action than any of the other local anaesthetics.

Alypin, Beta-eucaine Lactate, Novocaine and Tropacocaine are approximately equal in this respect to Cocaine, whilst Nirvanine is inferior.

They all act in the same way by combining with the nerve element, poisoning it and rendering it temporarily functionless. They all act on sensory nerves before motor, and after absorption they act on the central nervous system.

There is :

(1) Primary Stimulation.

(2) Secondary Depression and Paralysis.

If the toxicity of Cocaine be represented as 1, then from experiments performed on rabbits, the toxicity

of	Alypin	will represent	1.25
"	Nirvanine	" "	0.714
"	Stovaine	" "	0.625
"	Tropacocaine	" "	0.500
"	Novocaine	" "	0.490
"	Beta-eucaine Lactate	"	0.414

Now as Alypin is more toxic than cocaine and Nirvanine is only slightly less toxic and does not possess the same anaesthetic power, only the last 4 drugs are left for consideration. Further experiments regarding their action on the tissues with which they come in contact, have elicited the following important points, viz:-

1. Cocaine (10%) is only slightly irritant. Slight swelling and Hyperaemia appears soon after the injection, but the part completely recovers.

2. Stovaine (10%) is much more irritant. Causes intense Hyperaemia and dilatation of the blood vessels, followed by sloughing.

3. Tropacocaine (10%) is also irritant. Causes swelling followed by sloughing.

4. Novocaine (10%) is practically non-irritant. The part appears perfectly normal after the injection and remains so.

5. Beta-Eucaine Lactate (10%) causes swelling and thickening followed by sloughing.

Thus in regard to the irritant action of these drugs on the tissues, Novocaine is the only drug superior to Cocaine in this respect.

All are compatible with Adrenalin.

To demonstrate the rapidity of absorption and excretion of these drugs, experimental research has been made (7) on dogs, the drugs being injected into the subarachnoid space. From these experiments it was seen that with

1. Tropacocaine.

After 3 hours It was still present in cerebro-spinal fluid.
" 6 " Begins to appear in the blood.
" 9 " Only traces in cerebro-spinal fluid, maximum in blood.
" 12 " None present in cerebro-spinal fluid. present in urine.
" 16 " None present in blood. Trace in urine.
" 20 " None in urine.

2. Novocaine.

After 12 hours Still present in cerebro-spinal fluid.

" 16 " Begins to appear in blood; never reaches any considerable quantity.

" 30 " None in cerebro-spinal fluid. Still in blood.

" 36 " None in blood, still in urine.

" 40 " None in urine.

3. Stovaine. Remains longest in the cerebro-spinal fluid.

After 30 hours Present in cerebro-spinal fluid. Not in blood or urine.

" 33 " Appears in blood.

" 36 " Appears in urine.

" 48 " Disappears from urine.

In determining the most suitable substitute for Cocaine, we see comparing first Novocaine with Tropacocaine that although in most respects their actions are rather similar and that in toxicity and anaesthetic power they are roughly equal, yet the irritant action of Tropacocaine is much greater than that of Novocaine hence it is inferior.

The toxicity of Beta-eucaine lactate is only very slightly less than that of Novocaine whilst its irritant action is far greater and Novocaine is recognised as the more preferable of the two.

Stovaine is more toxic and more irritant than Novocaine, hence Novocaine is probably the most satisfactory drug to use. Stovaine possesses the advantage however of being the better anaesthetic although its specific action on nerve fibre is less than that of Novocaine.

Up to the present my experience has been limited to Stovaine and I have had no cause to be other than very satisfied with it. Should however Novocaine prove the most efficient drug in the long run I should be most willing to adopt it.

THE PRESENT-DAY TECHNIQUE OF SPINAL ANALGESIA.

Spinal Analgesia is a condition which results from the introduction within the spinal membranes of some substance which acts upon the nerve centres or roots, and produces insensitiveness to pain in the regions supplied by them. The substance most generally employed is a synthetic body called Stovaine, which is prepared in sterilized solution in glass ampoules containing 0.1 gramme; as a rule 6 - 8 centigrammes are injected into the cerebro-spinal cavity but often a dose of 5 cg. or even 4 cg. (centigrammes) will suffice.

In technique the process is simple but as attention to detail is so very essential to the success of the Analgesia and to the welfare of our patients, we must consider it fully.

In the first place, in the preparation of patients for the operation it is wise not to withhold food from them as is the custom when the patients are to be subjected to general anaesthesia, unless there is some special contra-indication, as in stomach operations. This point alone helps materially in maintaining the patients courage, and if the surgeon is skilled in the method and technique of producing spinal analgesia, the cases of imperfect analgesia will be non-existent. The failures are, almost invariably due to some flaw in technique.

Again the administration of castor oil on the evening preceding the operation tends to minimise the headaches sometimes complained of after lumbar puncture.

On the day preceding the operation a sufficiently large area of the patient's back is thoroughly disinfected thus -

The field of operation is shaved and well washed with ether, soap, and water, then rubbed with ether and finally washed with some antiseptic before the application of the compress. Then on the operating table, immediately before puncturing, the compress is removed and the back again washed with soap and water, then with 96% alcohol, all traces of which are finally removed with sterilized saline solution. This preparation is important should time permit of its being carried out but in the case of an emergency operation, washing of the back with hot water and soap and then rubbing it with alcohol will suffice before puncture. In Germany this is the procedure in all cases.

Of course the surgeon's hands should be rendered as aseptic as possible, and sterile rubber gloves should be worn. Before puncturing it is wise to explain to the patient what to expect - a prick in the back with a needle followed in a few moments by a feeling of warmth in the legs, then a sensation of pins and needles and numbness and finally inability to move the legs. If the patients are told this before the operation and assured that these queer sensations will all disappear after the operation,

it does a great deal to calm their feelings and remove any anxiety. These various sensations now-a-days are becoming so familiar to the public from the reports of those who have undergone the operation, that the patients really know now what to expect.

It is very essential that the patient should see nothing of what is going on, and to ensure this a screen should be so adjusted before the face to obscure the field of operation.

If this is not available a bandage over the eyes, or motor-goggles with opaque glasses, answers the purpose well, but this rather prevents one from observing the various alterations of expression of the countenance during the operation.

Again in very nervous patients the ears should be plugged with moistened cotton wool to prevent them hearing the unavoidable rattle of the instruments. These little practical points add greatly to the patients comfort.

For the successful carrying out of the operation, a good apparatus is essential. For the last 2 years I have used Mr. A. E. Barker's pattern and find it most satisfactory. This consists of a syringe, needles and cannula.

The syringe is a glass one, of the 'Record' type with a metal plunger which fits most accurately. The action is exceedingly smooth and there is nothing about the syringe to get out of order. The needles are fine, sharp and made of nickel and possess closely fitting stilettes about 1 m.m.

in cross section. The points of the needles are bevelled as near a right angle as is consistent with their perforative power, for were they cut very obliquely with too long and slanting a point, it might happen that when inserted through the membranes of the spinal canal, part of the aperture would be in the subarachnoid space and part outside, so that unless a cannula were employed projecting beyond the point of the needle, part of the injected solution or all of it might escape outside the membranes, resulting in incomplete or even no anaesthesia at all. The cerebro-spinal fluid flows out alright, but the injected solution does not find its way within the membranes.

That this was the cause of failure in two of my earlier cases, I am convinced, and this technical flaw has been entirely overcome since using the cannula, suggested by Barker. This cannula is attached to the syringe, which is filled with the drug compound through it. When the puncture with the hollow needle is made and the cerebro-spinal fluid has flowed out to the amount of about 10 cc., the cannula still attached to the charged syringe, is passed through the needle until its cone closes it. The point of the cannula which is quite blunt now projects beyond the point of the needle by about 1 millimetre, and must be within the dural sac. On now emptying the syringe, the contents must be delivered within the canal, although only half of the oblique terminal opening may have penetrated it.

It is an advantage to puncture the skin with a fine knife before inserting the needle, the skin having first been rendered anaesthetic by a spray of Ethyl Chloride.

The whole apparatus can easily be sterilized but in the process there are 2 points of practical import which require attention.

1. It must be placed in cold distilled water, which is gradually boiled, otherwise the glass barrel of the syringe is liable to crack.
2. In the water there must be no trace of soda or other alkali for these at once destroy the analgesic property of the injection compound.

The apparatus should be used for the production of Spinal Analgesia alone, and on no account should the needles be used for puncturing or evacuating any septic foci. The strictest attention to asepsis is absolutely essential and no-one not au fait with this should attempt the method.

After use the apparatus must be thoroughly cleaned and dried, and the piston of the syringe kept separate from the barrel.

Before proceeding further, an anatomical point of prime importance in connection with Spinal Analgesia must be considered for upon the knowledge of this, depends in a large measure, the success of the method. Lying between the nerve roots forming the right and left halves of the canda Equina in the lumbar sac, is a narrow elongated

space filled with fluid, which was first described by Quincke. In the depth of this fissure seen from behind lie the point of the conus medullaris and the filum terminale. The cleft is broader above than below being about 2 - 5 m.m. wide in adults. It has been named by Dönitz, the "Cisterna Terminalis" on account of its analogy to similar formations in the medulla, cerebrum and cerebellum.

The point of practical interest is that if the cisterna is punctured there will be a free flow of cerebro-spinal fluid and if an anaesthetic solution be now injected it can extend freely in all directions, especially upwards, producing a complete and extensive analgesia.

On the other hand if the needle has penetrated between the nerves taking part in the formation of one half of the Cauda Equina, the aperture of the needle may become partially blocked and the flow of cerebro-spinal fluid from purely mechanical reasons may be greatly impeded. The anaesthetic compound now injected is caught between the nerves of the canda and can only extend with difficulty. Hence the necessity of being able to puncture with precision the Cisterna for a successful anaesthesia, and to do this with the greatest ease one must adhere rigidly to the median plane. A rapid flow of cerebro-spinal fluid proves that we have attained our object. When the anaesthetic compound is now injected, a slight elevation of

the pelvis will cause it to travel up the spinal canal to the dorsal curve, and thus produce a high anaesthesia. If on the other hand the compound has been deposited between the nerves of the canda, the raised pelvic position is usually futile because the compound becomes entangled amongst the nerves and cannot ascend to any appreciable extent. This is probably the explanation of some of the inadequate analgesias met with.

Again the position of the patient during the injection demands attention. There are 3 positions to choose from. The sitting, the lying and thirdly, the abdominal.

(1) In the first, the patient sits crosswise on the edge of the table with the back rounded to its fullest extent, without any lateral bending, and the arms hanging down.

(2) In the second, the patient rests on either side with the chin approximated to the drawn up knees so that the arching of the vertebral column increases the space between the lumbar spines. A blanket folded 4 times or a small padded board about 2" high is placed under the buttocks, while the head rests on a pillow.

(3) In the third, the patient lies on his face with sand bags beneath the abdomen.

The puncture to gain entrance to the lumbar sac may be made either medially or laterally.

If the median method is employed correctly, the needle passes straight in to the cisterna terminalis.

The lateral method is more difficult and not so satisfactory. Here the needle pierces the skin to one side of the median plane and is directed towards the median line to enter the cisterna. One very often however lands amongst the nerve fibres of the right or left half of the cauda when the fluid will not flow freely. To produce a free flow the meninges may have to be punctured several times - a proceeding which is unsatisfactory. Again with this method one very often draws blood because the venous plexuses within the canal are situated to the side of the median plane. In puncturing mesially it is rare to see a trace of blood, there is no danger of puncturing the nerves of the cauda; which produces great pain, and the analgesia which follows the injection is usually excellent.

With the lateral puncture if one does not happen to strike the cisterna, one cannot rely on a good analgesia following on the injection. The compound becomes entangled amongst the nerves and is very liable to cause local irritation which might lead to unpleasant after effects. The inability of the injection compound to travel up the canal owing to its entanglement amongst the nerves, and its slow rate of diffusion might easily account for imperfect and unilateral analgesias. In my

earlier cases I always employed the lateral method but have now totally abandoned it, in favour of the median with much more satisfactory results.

In choosing a site for injection one must see that it is below the termination of the spinal cord, which ends at the disc between the 1st and 2nd lumbar vertebrae. The dural sac extends down to the 2nd or 3rd sacral segment so that the puncture can be made with safety between the spinous processes of the 2nd and 3rd, 3rd and 4th, 4th and 5th lumbar vertebrae. It really is not of much import which space is chosen so long as one paralyses the nerves supplying the area of surgical interference.

It is usually an easy enough matter to count the various lumbar spines but in stout subjects we may find this impossible. In such cases a good guide is the 4th lumbar spine which lies in the horizontal plane at the level of the highest points of the iliac crests.

Having chosen the space, freeze the skin with a spray of Ethyl Chloride and make a tiny puncture with a fine knife. This I consider an important point because it prevents the needle becoming contaminated with any micro-organisms from the skin, and also prevents the point of the needle from becoming blunt.

The needle should then be inserted immediately below the spinous process bounding the space and directed forwards and very slightly upwards. If it should happen to

strike bone, it should be withdrawn a little and inclined a little more upwards. After it passes the supraspinous and interspinous ligaments very little resistance is felt. The needle feels as if it were crossing an empty space. Then there is a sensation of having punctured a tense membrane and the cerebro-spinal fluid flows out in rapid drops, or may be in a continuous stream. One must wait for a good flow before injecting and it is courting certain failure to inject without first obtaining a flow.

The depth to which the needle is inserted before fluid flows varies from 1½" to 3½" or even 4" according to the stoutness of the patient. When the fluid is flowing freely hold the needle steady and insert the cannula attached to the syringe containing the dose to be injected. Here again there are some variations in technique.

The drug compound may be injected directly the fluid flows, after the escape of 10 or 12 c.c. or it may be mixed with cerebro-spinal fluid which is re-injected.

The method most commonly employed in England is to allow the escape of about 10 c.c. of fluid before injecting because otherwise there is a danger of raising the tension within the canal and so producing a tendency to headache. In fact, violent headache which has been reported in some cases has usually been relieved on performing a lumbar puncture and allowing some cerebro-spinal fluid to escape. A point should be made of injecting

the liquid as slowly as possible, and this having been accomplished, the needle is quickly removed and the puncture wound sealed over with gauze and collodion.

The patient is then turned over on to his back, the compress is removed and the field of operation finally prepared. By the time this is completed and the towels &c. are adjusted, the surgeon may commence the operation. Before doing so it is well just to test the tendon and skin reflexes to estimate the height of the analgesia. This simple method does not give the patient any pain or anxiety. Throughout the operation and for some time after the patient's removal to bed, the head should be kept in the elevated position.

This is the method employed in England, and that on the Continent varies but slightly from it. Thus in France it is customary to give a preliminary injection of a $\frac{1}{4}$ grain of morphia, and to employ the 'Lateral' puncture.

Also the sitting position is adopted wherever possible for the injection. It is certainly the easiest but in my opinion not the best, especially if a heavy drug compound is to be used. This brings us on to an important consideration - the physical factor in the production of spinal analgesia.

How does the analgesic compound, injected say in the 2nd or 3rd interspace, produce analgesia as high as, or even higher than the mid-dorsal region? The only 3 ways in which this can occur are:

(1) by slow diffusion.

(2) by shifting of the whole column of the cerebro-spinal fluid, in which it is suspended, upwards.

(3) by gravitation, if the injected compound is heavier than the Liquor Spinalis.

~~Liquor Spinalis~~.

On this point there is considerable diversity of opinion amongst the various authorities. Thus Dönitz, an exponent of Biers method, states it is not a question of diffusion, but simply one of shifting of the balance in the Liquor Spinalis which takes place at the moment of the change of posture. Thus he accounts for the upward extension of the injected compound by the alteration in the position of the patient immediately after the injection. For a high extension in Germany, the Trendelenburg position is made use of, but in England we find this unnecessary. No mention is made by Dönitz of gravity taking any part in the upward extension of the drug. In fact, he emphatically states that it is not a question of gravity on the analgesic compound nor of Hypothetic currents.

Rehn, of Frankfort, studied the method of transmission of injected fluids in the spinal canal and he explained it by diffusion, to a limited extent, and by the existence of a current in the Cerebro-spinal fluid from below upwards carrying with it the injected fluid.

From numerous experiments performed on various animals, he showed that an injection given in the Lumbar region of the canal, reached the cerebral ventricles within half an hour, whatever the position of the animal. That is to say the injected fluid becomes uniformly distributed in the Cerebro spinal fluid within half an hour.

He found that the anaesthetic solution was more quickly

diffused to the superior nerve centres in the horizontal than in the upright position, and that it was only absorbed after a certain length of time.

In some cases in Germany, inversion has been carried to an extreme degree, without any elevation of the head, with the idea of displacing the whole mass of Cerebro spinal fluid towards the Cranial Cavity. The analgesic compounds, however, have usually been of low specific gravity, e.g. Biers Compound (Stovaine 4% Na Cl. o. 11% Epirenin Borate 0.01%) with a specific gravity of 1.0058, actually lighter than the Liquor Spinalis, (Sp. gr. 1.0070) so that they would be unlikely to move as far as the neck by any oscillation of the column of the Spinal fluid. In some cases however the Analgesia has extended over the whole head and neck, without any apparent injury.

With an injection compound of lighter specific gravity than the liquor spinalis, the German views - diffusion aided by oscillation of the whole column of the Cerebro Spinal fluid, are probably correct as to its mode of action, but that this is the best method has I think been definitely disproved by Barker.

He pointed out that although Analgesia could be satisfactorily produced by this method, there was no means of controlling its extent and too great elevation of the Pelvis might prove dangerous. It occurred to him that the action of Gravity on an injection Compound of a greater specific Gravity than that of the Cerebro-Spinal fluid would have the desired effect of localising the drug to the most dependent part of the canal and so limiting its action to that particular area. This heavy

compound would sink to the lowest part of the canal independent of any displacement of the Cerebro-Spinal fluid. Acting on this contention he had prepared a solution of Stovaine 10% Glucose 5%, and Distilled water 85% (Sp.gr.1.0300) and by experiments with it both on the Cadaver and on the living subject, conclusively proved that the action of Gravity could play a very important part in the method of Spinal Analgesia.

It was no doubt on account of this same action that the French met with such good results. They employed Chaputs Compound (Stovaine 10% Na.Cl. 10% Distilled water 80%) with a specific gravity of 1.0831. This compound is first ~~just~~ mixed with some of the Cerebrospinal fluid withdrawn before it is injected. In substituting Glucose for the 10% NaCl. Barker has probably taken an important step for this renders the compound slightly viscid and consequently limits the diffusion to some extent, so that a smaller dose may suffice in place of a larger one, thus limiting as far as possible toxic effects of the drug.

A study of the Spinal Curves on a frozen section of a Cadaver shows that with the body supine, the highest point of the canal is in the Cervical region, and the next highest between the 3rd, 4th Lumbar Vertebrae, the classical point for Puncture. From this last point the dural tube inclines in both directions towards the Caudal and Cephalic extremities. The former ends for the dura opposite the 3rd Sacral Vertebra whilst the latter slopes from the point of puncture downwards as far as the 5th or 6th Dorsal Vertebra, when it begins to ascend again to reach its highest point at the 3rd Cervical Vertebra. With the head

thrown forward on a pillow, the foramen Magnum is the highest point in the Spinal Canal.

As it is practically impossible to inject with the patient supine the difficulty is overcome by doing it with the patient lying on the side and then rolling him on to his back without ~~allowing~~ altering the relative positions of the head and buttocks. The heavy compound pools at the most dependent part - i.e. about the 5th or 6th Dorsal Vertebra as is seen by the almost constant level of the upper limit of the Analgesia at the Episternal notch. This varies slightly however according to the forward bend of the neck altering to some extent the dorsal curve.

Again if the patient is injected in the sitting posture and then put in the lithotomy position, the analgesia is mainly in the perineum, showing again the action of gravity on the heavy compound.

But perhaps the most conclusive test of all was when Barker injected with the patient on the side and maintained the lateral position throughout the operation when analgesia was present only in the dependent limb, the upper one retaining its normal sensation and motion throughout. The only possible explanation of this could be that the heavy analgesic compound flowed along the lower lumbar nerve roots without any diffusion.

After injection with the patient lying on the side a unilateral Analgesia may be obtained which can be converted into a bilateral one simply by rolling the patient on his back.

Thus by making use of a heavy injection compound and taking into consideration the conformation of the spinal curves it is obvious that the Trendelenburg position becomes unnecessary. Still with the head well forward great elevation of the pelvis would probably be required to produce actual danger.

After injection an examination of the patient's sensations shows that sensibility to heat, pain and cold disappear first. Sensibility to touch and pressure disappear later while the pain of pressure is not abolished unless the tactile sensations of pressure are diminished or lost.

From the fact that complete abolition of sensation and motion can be obtained in one leg without interference with the motor or sensory function of the other limb it shows that the afferent mechanism attacked by the drug is concerned with the sensory impulses before they have crossed the spinal Cord.

Stovaine does not attack the long afferent Columns, at any rate, at first. It probably acts on the motor and sensory fibres in the spinal canal, or just after they have entered the spinal cord. The upper level of the loss of sensation seems to resemble that found in affections of the roots, rather than that produced by lesions of the spinal Cord. The borders correspond roughly to root segments. Cutaneous sensibility to pain, heat and cold is usually lost to a higher level than the sensations produced by touch and pressure.

After the injection the patient feels a sensation of formication and tingling, then the legs begin to feel warm, and later heavy, and finally he is no longer able to move them.

This motor paralysis is an almost constant result of Stovainisation. When the patient is injected in the sitting posture the sequence in which the Analgesia appears is somewhat different. First of all it is observed in the perineum and genital organs, then in the feet, gradually mounting into the legs and thighs, and finally it ascends into the abdominal regions. When the action is normal and correct it is interesting to note how rapidly the Analgesia mounts upwards. At the end of 5 minutes the patient is so completely analgesic that operations can be commenced on the Rectum and lower extremities. In the upper abdomen however it is well to allow about 8 or 10 minutes to elapse before starting the incision, although some patients have become analgesic as high as the nipple line in so short a space as 5 minutes after the injection.

The analgesia disappears in the reverse order of its appearance, consequently the time at our disposal for operations on the upper abdomen is not so long as that for operations on the legs. The average duration of the analgesia is about 50-60 minutes, but it may last as long as 4 hours.

During the operation the patients usually lie perfectly quiet and feel well. They may be a trifle excited at first but they are rarely sick and seldom complain of headache.

It is well perhaps to keep up a conservation with them on some indifferent subject. They appear to take so little notice of what is going on, that during the whole operation they will not evince a single sign of pain.

When however peritoneal adhesions are being dealt with, evidence of some discomfort is sometimes noticed. They may even vomit, but when asked if they are in pain they will usually reply that they have only an unpleasant sensation.

In the majority of cases, though, everything passes off smoothly and even when some of the most formidable operations in Surgery are being performed, it is astonishing to see the utmost indifference displayed by the patients and their apparent well-being at the completion.

The pulse before the injection may be rapid but it usually slows down, sometimes very much so after the commencement of the operation. It is quite possible that Stovaine has some direct action on the heart's activity.

In the after-treatment of the patient it is important to bear in mind one or two points.

The head and upper part of the body must be kept raised on pillows for some hours after. Great care must be employed in using hot water bottles as the patient is unable to judge of temperature and serious burns might be inflicted. With the object of counteracting any headache, 5 grains of Pyramidon may be given, and if there is no contra-indication a dose of Castor oil.

5. The advantages and disadvantages of Spinal as compared with General Anaesthesia:-

In the complete abolition of shock lies the signal advantage of spinal Anaesthesia. Everyone who has employed the method has been struck with this fact. Dean, of London, thinks it is especially in such cases. As for example, double amputations after accident that the field of highest advantage of this method will be found eventually. Cushing found that the preliminary injection of the nerves supplying the area of operation abolished the phenomenon of Shock and in intraspinal Analgesia we simply have an elaboration of this method, the sensory impressions resulting in shock, being blocked at the posterior nerve roots instead of in the course of the nerve trunks. Again its beneficial effect in some cases of peritonitis in combating paralytic distension of the gut, which so often occurs after general anaesthesia, is a very great advantage.

Then in certain conditions, where owing to Cardiac or Pulmonary affections the administration of a general anaesthetic would be attended with grave danger, Spinal analgesia may be undertaken with comparative safety. In fact several cases are on record where the patients condition under general anaesthesia was so ominous that the operation could not be proceeded with in safety whereas spinal analgesia a day or so later gave rise to no alarm.

Another important point is the saving of the time due to the rapidity of the Analgesia. While this is progressing

the seat of operation may be got ready, and by this time the operation may be commenced. It is of advantage also to be able to take food immediately before and after the operation and to be free from the sickness and unpleasant taste in the mouth consequent on the administration of a general Anaesthetic. One has only to compare the appearance of the patient who has been anaesthetised by spinal Stovainisation, and that of one who has been rendered insensible by the aid of Chloroform or Ether. The former is calm, smiling and self-possessed, feeling rather proud of his novel experience, while the other is absolutely prostrate or feeling miserable with retching and vomiting. The former too can be seen by his relatives immediately after the operation and can at once engage in intelligent conversation with them.

Again in abdominal operations relaxation of the muscles is perfect, and owing to their temporary paralysis, no straining can take place. From the Surgeon's point of view the absence of strain on the abdominal sutures by retching or on the sutures of a herniotomy by unconscious and often forcible movements of the hip joint, is a very pleasing factor.

In circumstances where the Surgeon is shorthanded and is obliged to act both as anaesthetist and operator spinal analgesia is invaluable, for he is relieved of all anxiety so far as the anaesthetic is concerned.

Finally in every case in which a patient has had experience of both General and Spinal Analgesia, the fact

that his opinion is invariably in favour of the latter as the more pleasant to take, surely speaks for itself.

But the method also possesses some disadvantages, for it is unfortunately not yet ideal. In the first place one may fail to puncture the Spinal Theca. This misfortune has occurred to most operators but is fortunately very rare. However it is a contingency to be remembered.

Then again faintness, nausea or actual sickness sometimes comes on about 10 minutes after the injection, probably owing to visceral engorgement and consequent cerebral Anaemia due to relaxation of the abdominal walls. Firm pressure over the abdomen will counteract this, but the nausea as a rule is but momentary and rapidly passes off.

Headache is probably the worst sympton. Its presence is of fairly frequent occurrence, occasionally during the operation but usually some 12 or 24 later. Although it has been described as terrible by some, in most cases it is trivial. It is usually easily controlled by Aspirin gr. x-xv. but in some cases it has been necessary to resort to Lumbar Puncture. Pain in the back and Vomiting may be troublesome - but one very rarely sees these after-effects. Urinary troubles in the form of Retention or Incontinence sometimes come on for a few days after the operation, but as a rule they soon pass off. One disadvantage is that when dealing with peritoneal adhesions, or putting traction on the omentum a feeling of discomfort in the epigastrium is sometimes experienced by the patient. In some cases this has

been so obvious that a little Chloroform or Ether has been administered to overcome this. Again Haemorrhage after operation sometimes occurs if one is not very careful in securing all the bleeding points. Blood-pressure is lowered by the action of Stovaine and although the wound may appear perfectly dry at the completion of the operation oozing may occur some hours later, after the effect of the drug has passed off. This happened in two of my cases. But the greatest disadvantage of all is the element of uncertainty in the Analgesia. It may not have risen high enough for the field of operation or its appearance may be very late. These faults however I am convinced cannot be attributed to any refractory behaviour of the patient towards the Anaesthetic, but must be sought in some technical flaw in the administration. All of us have noticed the waywardness of the analgesia in some of our earlier cases but that the trodden path is the correct one is proved by the fact that practice of the method has robbed the procedure of a great part of its capriciousness.

6. Indications for Spinal Analgesia:-

The great indication for Spinal Analgesia is in those conditions where a general anaesthetic is contra-indicated on account of some cardiac or other disorder or when a general anaesthetic has been tried and failed. To know that we have in Spinal Analgesia a method on which we can fall back in such cases is a great asset to our resources.

Personally for any operation where one can certainly rely on a sufficiently high analgesia, I think the patient should be given the option of Stovaine, for in my hands I have found it very safe, and to produce but trifling after-effects. Up to the level of the umbilicus one can usually obtain an excellent analgesia, while on 5 occasions I have performed long operations with it, at a much higher level.

In cases where great shock is anticipated and where one fears subsequent paralytic distension of the bowel, Spinal Analgesia is the anaesthetic to use "par excellence" It is particularly in such cases where it is of such value.

In feeble old people with marked arteriosclerosis and Cardiac trouble, it is probably safer to use Stovaine than a General Anaesthetic, but any anaesthetic and any operation in very feeble old people is fraught with considerable danger.

Tuffier, whose experience of Spinal Analgesia is probably as extensive as anyone's, limits the indications of the method to cases in which its success is certain, and where local analgesia is impracticable. Thus he uses the method for operations on the lower extremities, perineum, rectum,

genital organs, and hernial region, but has entirely abandoned it for major abdominal operations, and for operations on the Thorax.

In my experience, however, it has been in certain grave major abdominal operations that I have found the method most valuable.

Some men use the method for operations on the thorax and upper extremities and Jonnesco of Budapest has gone so far as to produce anaesthesia of the Head and neck by intracervical injections. With pure stovaine the method proved dangerous. In order to counteract the paralysing action of Stovaine he added atropine Sulphate, the solution consisting of 0.08 c.g.m. of Stovaine, with $\frac{1}{2}$ m.g.m. of Atropine Sulphate in I.C.C. of sterilized water. With this solution he was able to produce anaesthesia in the head and neck with good results. This method appears very heroic and in my opinion fraught with considerable danger. It aims at paralysing regions which in the method ordinarily employed we particularly try to avoid.

In considering however the future of Spinal Analgesia we must take into consideration a new method of producing local anaethesia introduced by Bier towards the end of 1908. He claims that for operations on the extremities it is preferable to rachistovainisation, and in his practice he is substituting it for Stovaine, thus limiting the indications for the latter.

The method consists in producing anaesthesia of the limbs by intravenous injections, together with artificial ischaemia. The limb is first elevated and rendered bloodless by the

application of a constrictor. Tourniquets are then applied above and below the proposed field of operation, the principal vein or one of its tributaries is exposed in the distal portion of the field and through a canula secured in a small longitudinal incision in the vein is introduced 50 to 80 c.c. of a 5% solution of novocaine in normal saline. It is not so much the quantity of anaesthetic injected as the production of complete ischaemia which is effective. In all cases in order to avoid danger the liquid should be injected downwards towards the lower limbs, and not towards the heart.

The injection of the solution is made under considerable pressure in order to distribute it through all the tissues between the tourniquets.

In from 3 -4 minutes complete anaesthesia is obtained and the only drawback is that it lasts such a short time - 5 to 7 minutes. The addition of adrenalin has prolonged the anaesthesia in some cases to 20 minutes.

Bier has performed a large number of operations with this "Intravenous Anaesthesia" and in only a few cases was it necessary to produce an aesthesia by other means in order to complete the operation.

On the completion of the operation, and before the tourniquets are removed, the novocaine solution is allowed to escape, and as an extra precaution the veins may be washed out with a saline solution.

This method of local regional anaesthesia is of course limited to the extremities and in such cases may prove a serious rival to spinal anaesthesia.

7. Dangers and Contra-indications:-

From a study of my cases and those of other surgeons I believe that in the method employed in this country we have a very valuable and perfectly safe proceeding. The only alarming symptom in my series of cases was Collapse in a child aged 4. To inject a small quantity a toxic agent into the Lumbar Sac is not necessarily more dangerous than charging the whole system with a poison such as Chloroform, and so far as the immediate and remote after-effects are concerned, according to English Statistics, we have nothing to fear. Thousands of individuals have undergone the injection since its introduction and now years after few can point to troubles accruing from it.

The danger of Sepsis with septic meningitis should be nil, if a proper regard is paid to asepsis whilst the toxic effects of the drug can be minimised by due attention to dosage. It is seldom necessary to inject more than 5 c.g.m. of Stovaine no matter how severe the operation, for with an intelligent appreciation of the technique a high analgesia can be secured with it. In referring however to the Continental Literature one is struck by the large numbers of unhappy issues experienced by most surgeons who employ the method. The dark side of the picture is very strongly painted by P. Hardouin, who relates 16 fatal cases. It is only fair to state, however, that in several of them there seems to have been a disregard in the Technique of those very points to a careful regard of which, we attribute safety.

Sudden and considerable elevation of the Pelvis in certain old patients has been followed by Syncope and a fatal termination in some cases. Hartmann relates two such fatalities.

But apart from fatal issues many other serious disorders have been recorded.

Thus more or less permanent paralysis has been stated to result in some cases but I have heard of no such accident occurring in this country. The probable explanation of such cases is to be sought in the combination of other drugs with Stovaine, e.g. Adrenalin. This drug which is fairly commonly used on the Continent to prolong the Analgesia, is particularly dangerous, since its action depends on the anaemia of the Spinal Cord which it produces. It is quite conceivable that the anaemia of the cord so produced, if unduly prolonged, might lead to death of the cells of the anterior and posterior Cornua, with resulting degeneration of their nerves.

Guinard has reported 2 cases of softening of the Brain following on Spinal Analgesia both of which terminated fatally within 12 months.

Other troubles reported are trophic disturbances in a few instances leading to patches of Gangrene of the skin, ocular Paralysis, Paralysis of the Facial Nerve, of the shoulder muscles, Retention or incontinence of urine, and incontinence of the bowels - a very formidable list.

These sad results have naturally made some of our

foreign confreres look on the method with some distrust and resort to it only in cases where general anaesthesia is absolutely contra indicated. Fortunately our results have been much more comforting and we have yet to see the dark side of the picture, if it exists.

Caution should be taken in dealing with very old people, for with them the administration of any anaesthetic is dangerous.

Again aming at such a high analgesia as of head and neck appears to me a distinctly dangerous procedure although Jonnesco has successfully performed intra'cervical injections. In conclusion I believe the method to be perfectly safe, if we pay due attention to technique and are content to limit the range of operation to the level of the umbilicus or slightly higher.

It is contra-indicated in Septic conditions, syphilis, Fevers, diseases of the Central Nervous System, marked scoliosis, young infants, Arterioscleriosis and widespread tuberculosis. It should not be used to produce Analgesia of the upper part of the Trunk, head and neck. The presence of bed sores or ulcers occupying the region of the 2nd Lumbar Interspace might render the injection impossible or at any rate, unsafe.

8. My personal experience of Spinal Analgesia has been limited to 56 cases in which I have used the method, and from what I have seen of it, I have found it extremely satisfactory. Commencing as I did towards the end of 1905, when the technique was not so perfect as it is now, I naturally did not meet with the unqualified success that I do now. Of the 56 cases the first 26 were performed in 1905-06 at the Hull Royal Infirmary. They comprised Inguinal Hernias 3, Appendicectomy 2. Removal of Pelvic Glands (Lymphadenoma) 1, Varicocele 3, Hydrocele 1, Removal of Semilunar cartilages 2, Genu Valgum 1, Wiring Fractured patella 2, Tarsectomy and Removal of Patellar Bursal 2. Thus it is seen with the exception of 2 abdominal operations the remainder were confined to the lower extremity and to the inguinal region.

In one case I failed to puncture but as the needle appeared to be within the subdural space the stovaine was injected, notwithstanding the fact there was no flow of Cerebrospinal fluid. At the end of 15 minutes there was no evidence of Analgesia at all, and a general Anaesthetic was resorted to. In two other cases the analgesia was incomplete having not extended sufficiently high, again necessitating the use of a General anaesthetic. A second puncture was not attempted. In both of these cases the flow of Cerebrospinal was slow and blood-stained. In all the cases Quincke's Lumbar puncture was employed, and in no case was the median puncture tried. The skin was neither frozen with

ethyl Chloride nor punctured with a knife before the insertion of the needle. Blood-stained fluid was frequently withdrawn, and sometimes pure blood. In such cases a second puncture was necessary. As the needle reached the canal a sharp pain was sometimes experienced, probably due to striking a nerve on the side of the Cauda Equina. The Pelvis was only very slightly elevated, and on no occasion was the Trendelenburg position used. The syringe employed was a large all-glass one, with a long steel needle. The opening at the point of the needle was fairly oblique. No cannula was used.

The Injection compound was according to Bier's formula Stovaine 4%, Na Cl. 0.11%, Eperenin Boratio, 0.1%, specific gravity 1. 0058. Thus out of the 1st 26 cases there were 3 failures. In one case the injection compound evidently did not get within the spinal membrane, whilst in the other two, I fancy some was deposited inside and some outside the membranes. The needle had probably just punctured the membranes and as its terminal opening was oblique, part of it may have been without the thecae. Thus although the cerebro spinal fluid could flow out, probably some of the injected solution escaped outside the membranes. It was noticed with these early cases that the analgesia seldom rose to the level of the umbilicus and took longer to develop than in the subsequent ones. The operation was seldom commenced before 10 minutes after the injection. With the exception of one case that collapsed on the table, and

caused anxiety for some little time, a case which I shall refer to later, there was nothing serious to note either in the immediate or remote effects. Nausea and faintness some 10-15 minutes after the injection, actual vomiting (rare) and Headache were the chief after effects, but these did not cause any great discomfort. In only one case was the headache at all severe, and this patient had met with a head injury 5 days before his operation. It was controlled however by Phenacetin.

Pain in the back was also sometimes complained of. As the bone was often struck by the needle, I have no doubt was due to some irritation of the periosteum. Applications of Lotio Plumbi cum opio used to relieve this.

After leaving the Hull Royal Infirmary in the middle of 1906, I did not have a further opportunity of employing the method until the middle of 1908. Since that date up to the present, I have used the method in 50 cases with very gratifying results. The list comprises, Inguinal Herniae 4, Colotomy 2, Diastema Rectorum 2, Appendicectomy 1, Strangulated Inguinal Hernia 1, Enterectomy 2, Fistulae in ano 2, Haemorrhoids 5, Excision of Rectum 1, Suprapubic Prostatectomy 1, Varicose Veins 5, Removal of PatellarBursa 1, Amputation of Thigh 1, Removal of undescended Testicle 1, Removal of Semilunar Cartilage 1.

In no case did I fail to puncture and in all the analgesia was very good. The median puncture was employed in every case, and from experience I can confidently say

that it is by far the simplest. It was exceptional not to strike the Lumbar sac right away, and the flow of fluid was almost invariably free. Very rarely was there a trace of blood. Bone was very seldom touched, the needle usually going straight into the Cisterna Terminalis. The skin was always frozen first with a spray of Ethyl Chloride, and then punctured with a fine knife before the insertion of the needle which was usually painless. The apparatus used was after Barker's pattern which I can speak of with nothing but praise. The Injection Compound was Stovaine-Glucose (A.E. Barker's) of specific gravity 1.0300.

It was noticed with this solution that the analgesia appeared quicker, reached a much higher level and was much more constant than the one I originally employed. On the average Analgesia has lasted about 50 minutes, but sometimes it has been much more prolonged.

The after effects have been very trifling, and there is not a single serious case to report. Headache was complained of in a fair proportion of the cases, but in none was it severe. Two cases, both women, had slight incontinence of urine which came on about 24 hours after the injection and lasted about 36 hours. The majority felt very comfortable during the operation and afterwards all those who had had experience of both general and Spinal Analgesia were greatly in favour of the latter.

Before concluding, I should just like to remark on a few of the more interesting cases.

1. Case 4. Child aged 4. 4 c.g.m. of Stovaine injected. (1905).

Operation. - Double Tarsectomy for marked Talipes Equinovarus. Puncture easy. Flow of Cerebrospinal fluid very free. Child appeared very frightened and cried all the time. Pelvis was only very slightly raised during injection. 15 minutes after the injection child became suddenly collapsed. Pulse became very feeble and respiration almost ceased. Skin cold and clammy. Condition was very serious. Liquor Strychninæ was administered and artificial respiration resorted to, and after 10 minutes the operation was continued.

The collapse in this case was I think due to shock, but it may possibly have been due to an overdose. This was the only occasion throughout my series that I attempted the method on a young child as after this experience I did not consider the injection safe. Deetz, however, I believe, frequently employs spinal analgesia for children with good results.

2. Case 9. Man aged 41. 6 c.g.m. of Stovaine injected. (1905).

Operation. Removal of Lymphadenatomous glands from Groin and Pelvis. This was a very extensive operation involving much deep dissection and the satisfactory condition of the patient throughout the operation and afterwards made me very hopeful of the method. The patient was very comfortable throughout.

3. Case 38) Woman aged 55. 5 c.g.m. of Stovaine injected.
" 42)
(1908). Operation: for intestinal obstruction of 3 days duration. At the operation a malignant growth was found in the Pelvic Colon, but the seat of obstruction was a growth at the Hepatic Flexure of the Colon. An incision was made over it and the growth which was movable brought outside the abdomen and removed later. At the 2nd operation, a fortnight later, the Pelvic growth was excised and an anastomosis made by a Murphy's button.

On both occasions the analgesia was perfect. There was slight nausea and faintness about 10 minutes after the injection each time, but it rapidly passed off. The patient was very pleased with the anaesthetic and had always had a dread of Chloroform.

Owing to her condition on admission a general anaesthetic was deemed inadvisable.

24 hours after the first injection she had incontinence of urine which lasted 36 hours. There was no recurrence of this symptom after the 2nd operation, and now, 6 months later, the patient is very comfortable and has had no trouble whatever with her bladder.

This case was a very interesting one, and I should say rare, with 2 growths - Columnar Celled Carcinomata - of the bowel, and I am pleased to say

she is so far keeping well.

Case 45. Man 65. 5 c.g.m. of Stovaine injected. Operation: Strangulated Inguinal Hernia (Left side) of 48 hours duration.

Analgesia perfect. Constriction at neck of sac, tight. This Hernia was interesting in that it contained large Intestine only. Patient was very comfortable during the operation, and suffered from no shock whatever. The bowels were moved at the completion of the operation before he left the table, and recovery was uneventful. I venture to say that after general anaesthesia I should have had some difficulty in getting his bowels to act.

Case 51. Man aet 50. 5 c.g.m. of Stovaine injected. Operation: for Intestinal obstruction of 60 hours duration. Patient was very distended and it was impossible to detect the site of obstruction.

After the injection the abdominal muscles relaxed so beautifully that a swelling was palpable in the right Iliac region, over which the incision was made. Gangrenous Bowel presented, and it was seen that the obstruction was caused by a Meckel's Diverticulum. 45 inches of small intestine were removed and a lateral anastomosis between the ileum and Caecum performed. The patient was very comfortable throughout the operation, except for some troublesome

regurgitant foecal vomiting, and had absolutely no shock. Two doses of brandy were administered during the operation.

4 hours after the operation flatus was passed, and the following day the bowels moved. Pulse 76. Respiration 16. The patient was very comfortable considering the severity of the operation and there was not a sign of any paralytic distension. I very much doubt whether this patient would have stood a general anaesthetic, and in any case I am convinced that the after-effects would have been very serious if not fatal.

Case 52. Man aged 71. 5 c.g.m. of Stovaine injected. Operation: Amputation through lower third of thigh for senile gangrene of foot.

Patient had extremely marked arteriosclerosis and atheroma. Pulse irregular, 80.

Patient stood the operation excellently. Felt absolutely no pain and had no shock.

In this case a competent anaesthetist refused to administer a general anaesthetic as he considered the man's general condition too serious.

Of my cases the youngest patient was 4 years old and the oldest 86. Although my percentage of failures at first, in my first 26 cases, was high, 11.5%, in the last 50 cases with improved apparatus and technique there has not been a single

failure. The capriciousness of the analgesia becomes less and less with experience of the method and careful attention to technique, whilst its utility and value are fast becoming fully recognised. No one, I think, who has taken any considerable practical interest in the subject, will deny that in Spinal Analgesia our medical knowledge has gained a most noteworthy enrichment, and I am strongly of opinion that it has a great future before it, but that its scope will always be limited.

B I B L I O G R A P H Y.

B. M. J. March 23rd 1907. (10)

" Feb. 1st 1908 (11)

" Aug. 22nd 1908 (12)

" April 25th 1908 (13)

" May 30th 1908 (14)

" Feb. 6th 1909 (15)

" March 27th 1909 (

Lancet Oct. 24th 1908 (16)

" Sept. 5th 1908 (17)

" April 11th 1908 (18)

"Technique of Spinal Analgesia" E. Canny Ryall (1)

New York Medical Journal Oct. 31st 1885 (2)

Deutsche Zeitschrift Jur. Chirurgie. Vol. 51. p.360 (3)

La Semaine Medicale, May 16th 1900 (4)

Journal of American Medical Association, Sept 1st 1900 (5)

La Semaine Medicale 1899 (6)

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Münchener Mediz. Wochenschrift March 9th 1909 (8)

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Case.	Description.	Sex.	Years of Age.	Operation.	Flow of cerebro-spinal fluid.	Centigrammes of stovaine.	Reflexes gone.	Legs Heavy.	Perineum and Ext. genitals.	Feet and Legs.	Thighs & Groins.	Analgesia complete.	Duration.	Height of Analgesia.	Case.	Motion possible.	Condition during operation.	After effects.	Shock.	Pyrexia.	Remarks.	Opinion of patient.
1	Healthy Labourer	M	28	Varicose Veins, Legs & Thighs.	Single drops	6	2 min	3 min	5 min	6 min	10 min	12 min	65 min	1"below umbilicus	1	No	Very comfortable Pulse & Respiration normal	Headache next day. Relieved by Phenacetine.	None	T99.6°F	Analgesia Perfect.	Very pleased with method. Enjoyed tea on return to ward.
2	Spare woman nervous	F	32	Varicose Veins, Legs & Thighs.	Free	6	1 min	2 min	5 min	4 min	8 min	10 min	50 min	2"below umbilicus.	2	No	Slight faintness & nausea. Transitory P.110. R.20.	Slight headache	None	T99.8°F	Beginning to feel pain towards end of operation.	Preferred it to $CHCl_3$.
3	Healthy adult	M	30	Wiring fractured Patella	Free	6	at once	2 min	4 min	6 min	8 min	11 min	60 min	Umbilicus	3	No	Excellent	Very severe headache 2 days. Relieved by Phenacetine & Castor oil.	None	T100°F	Patient had head injury at time of accident. Analgesia perfect.	Very favourable.
4	Housemaid	F	25	Prepatellar Bursa	Single drops	6	1 min	3 min	5 min	6 min	9 min	12 min	45 min	1"below umbilicus	4	Very Slight	Some nausea & retching 5 mins after commencement of operation. P.80. R. sighing for a minute or two.	Slight vomiting.	None	None	Analgesia perfect.	Felt frightened at the beginning, but did not feel pain.
5	Healthy Seaman	M	36	Removal of displaced internal Semilunar cartilage.	Single drops	6	2 min	1 min	4 min	7 min	8½ min	12 min	58 min	2"below umbilicus.	5	No.	Very comfortable. P.& R. normal	Pain in back. Relieved by Lotio Plumbi c opio.	None	T99.6	Analgesia perfect. Had difficulty in inserting needle. At first only drops of blood came away. Needle re-inserted.	Rather enjoyed the novel sensation.
6	Healthy child	M	4	Double tarsectomy.	very free.	4	at once	Cried all the time							6	No	Very alarming. Collapsed 10 mins after commencement. P.very rapid & feeble. R.almost ceased. Required artificial respiration strychnine.	None	Great	T99.2	Probably an overdose for a child. Presented very alarming symptoms.	- - -

Case.	Description.	Sex.	Years of Age.	Operation.	Flow of cerebro spinal fluid.	Centigrammes of Stovaine.	Reflexes gone.	Legs heavy.	Perineum & scrotum.	Feet & Legs.	Thighs & Groins.	Analgesia complete.	Duration.	Height of Analgesia.	Case.	Motion possible.	Condition during operation.	After effects.	Shock.	Pyrexia	Remarks.	Opinion of Patient.
7	Plethoric adult.	M	46	Varicose Veins.	Slow	6	at once	2 min	5 min	4 min	7 min	10 min	80 min	umbilicus.	7	No.	Perspired a good deal 5 mins. after commencement. P.70. R.18.	Aching in legs.	None	T100.2	Analgesia perfect. Dressing through same night Wounds appeared perfectly dry at end of operation.	Felt rather uncomfortable at first.
8	Healthy adult	M	21	Varicocele.	Single drops	6	2 min	6 min	Analgesia insufficiently high.						8	Yes					Felt pain fairly acutely. General anaesthetic given.	
9	Adult	M	41	Removal of Inguinal & pelvic glands. (Lymphadenomatous.)	Free	6	at once	2 min	4 min	5 min	8 min	10 min	68 min	umbilicus	9	No	Fairly comfortable. Sighing, Respiration about 10 mins after commencement of operation. P.feeble 9 6.	Pain in back. Slight headache.	None	T100.8	Felt deep dissection in Pelvis slightly, said he could bear it alright.	Favourable. Preferred it to $CHCl_3$.
10	Healthy adult	M	41	Inguinal Hernia	Free	6	at once	2½ min	4 min	5 min	8 min	11 min	45 min	2"below umbilicus.	10	No	Very comfortable P.& R. normal	Slight pain in back.	None	T99.6	2nd puncture necessary. 1st drew blood only.	Favourable. Felt slight dragging sensation when cord was pulled on.
11	Healthy man	M	30	Removal of Internal semilunar cartilage.	No flow.	6	No analgesia. In 15 mins General Anaesthetic employed.								11	Yes	-	-			2 punctures were made & although needle appeared to be inside Theca. no fluid escaped.	
12	Thin Woman	F	38	Varicose Veins	Free	6	1 min	3 min	5 min	4 min	6 min	9 min	55 min	1"below umbilicus.	12	No.	Excellent. P.rose to 112, but soon came down to normal again.	Slight vomiting	None	T.100	Analgesia perfect. Tactile sensation not completely abolished.	Quite comfortable throughout.
13	Healthy Patient	M	25	Appendicectomy.	Free	6	at once	1 min	3 min	5 min	6 min	10 min	70 min	umbilicus.	13	No.	Very comfortable. Slight nausea 10 mins. after injection.	None	None	T.99.6	Some pain during separation of adhesions. Could bear it quite well.	Didn't mind it at all. Very comfortable on the whole.
14	Sailor	M	40	Large Vaginal Hydrocele.	Single drops	6	2 min	2½ min	4 min	7 min	9 min	12 min	35 min	1"below umbilicus.	14	No	P.100. R. 18.	Pain in back. Slight headache.	"	T.99.4	Analgesia perfect.	Didn't feel anything.

Case.	Description.	Sex.	Years of age.	Operation.	Flow of cerebrospinal Fluid.	Centigrammes of Stovaine.	Reflexes gone.	Legs Heavy.	Pereneum of Scrotum.	Feet & Legs.	Thighs & Groins.	Analgesia complete.	Duration.	Height of analgesia.	Case.	Motion possible.	Condition during operation.	After effects.	Shock.	Pyrexia.	Remarks.	Opinion of patient.
15	Healthy Youth	M	19	Inguinal Hernia & undescended testicle.	Free	6	1 min	2 min	2½ min	6 min	7 min	10 min	45 min	Umbilicus.	15	No	Slight nausea 15 mins after injection. P.110. R.16.	Headache slight	None	No	Felt pain slightly. Rather nervous.	Very satisfactory.
16	Healthy Patient	M	26	Cuneiform osteotomy femur.	Single drops.	6	at once	1½ min	3 min	5 min	7 min	11 min	40 min	2"below umbilicus.	16	No	Slight headache P.& R. normal.	None	"	"	Analgesia perfect.	Quite comfortable.
17	Stout woman	F	39	Varicose Veins.	Free	6	"	2 min	3½ min	6 min	8 min	12 min	35 min	"	17	Slightly	Pallor & sweating 15 mins. after injection. Pulse feeble.	Headache	"	T.100.2	Imperfect Analgesia towards end of operation. Required light General Anaesthesia.	Not over pleased with it. Pain felt towards end not very severe but she felt frightened.
18	Healthy young woman.	F	21	Appendicectomy	"	6	1 min	" min	3½ min	5 min	8 min	10 min	50 min	umbilicus.	18	No	P.96. R.16. Sighing respiration at commencement of operation.	Pain in back 2 days.	"	No	Dragging sensation during separation of adhesions. Analgesia good.	Felt nervous could easily bear the dragging pain.
19	Healthy young woman	F	23	Large Prepatellar Bursa.	"	6	1½ min	2 min	5 min	4 min	7 min	9 min	56 min	1"below umbilicus.	19		Some nausea 10 mins after injection.	Slight headache next day.	"	"	Analgesia perfect	Very favourable.
20	Healthy young adult	M	23	Varicocele	Free	6	at once	1 min	3 min	3½ min	6 min	8 min	60 min	Umbilicus.	20	No	Excellent P.& R. normal.	None	None	None	Analgesia perfect	Felt no pain at all.
21	Healthy adult	M	41	Wiring Fractured Patella.	Single drops	6	2 min	3 min	3½ min	5 min	8 min	10 min	45 min	2"below umbilicus.	21	No	Perspired freely at beginning. P. 100. R. 14.	Slight headache. Pain in back.	None	None	Analgesia perfect. 2nd puncture necessary. Blood came with 1st puncture.	Very satisfactory. Preferred it to Ether.
22	Healthy woman.	F	35	Varicose Veins.	Slow	6	2 min	4 min	5 min	8 min	12 min		?	Iliac crest	22	Yes	Slight vomiting 15 mins. after injection.	None	None	T99.6	Analgesia imperfect. Did not rise sufficiently high. Required light general anaesthesia. No after effects.	Did not like it.
23	Adult man.	M	42	Inguinal Hernia.	Free	6	at once	1½ min	3 min	5 min	6 min	10 min	65 min	1"below umbilicus.	23	No	Excellent Chatted all the time.	Headache.	"	T100.2	Analgesia perfect	Liked it much better than $CHCl_3$.
24	Healthy young adult.	M	21	Varicocele	"	6	"	2 min	4 min	4 min	6 min	9 min	40 min	1"below umbilicus	24	No	Excellent	None	"	"	Analgesia perfect	Felt no ill effects.
25	Healthy woman	F	28	Appendicectomy	Single drops	6	1 min	3 min	5 min	4 min	7 min	10 min		2"below umbilicus.	25	"	-	-			Analgesia not sufficiently high. Complained of pain & was given $CHCl_3$ No after effects.	-

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26	Healthy adult.	M	47	Varicose Veins.	Free	6	at once	1½ min	3 min	5 min	6 min	8 min	55 min	Umbilicus.	26	No	Very comfortable. P.84 R.16.	Slight Headache	None	T99.2	Analgesia perfect. At own request.	Very favourable.
27	Weakly adult	M	41	Large Fistula	Free	5	at once	1 min	2 min	4 min	5 min	8 min	45 min	2"below umbilicus.	27	Slight	Felt pins & needles in legs. P.76.R.14	Slight headache.	"	T100	Analgesia perfect.	Felt quite comfortable throughout.
28	Healthy adult	M	38	Haemorrhoids.	Free	4	"	2½ min	1 min	5 min	7 min	9 min	50 min	Iliac crests	28	No	Excellent. P. & R. normal.	Slight headache. Sharp pain in rectum when analgesia passed off.	"	None	Analgesia perfect. Operation by ligature.	Felt no pain.
29	Anaemic adult	M	28	Haemorrhoids	Free	4	at once	2 min	1 min	3 min	5 min	7 min	40 min	Iliac crests	29	No	Very comfortable. Chatted all the time. P. & R. normal.	Sharp pain in rectum when analgesia passed off.	None	None	Analgesia perfect. It is very remarkable the way the sphincter dilates.	Didn't feel it at all.
30	Thin weakly adult.	M	50	Excision of rectum.	Free	5	"	1 min	2 min	4 min	5 min	10 min	65 min	Iliac crests	30	No	Some nausea & retching. 12 mins after injection P.rather feeble 110.	Pain in back.	None	T101.2	Could feel a dragging sensation when rectum was being pulled down. Not very painful.	Preferred it to ether.
31	Healthy old woman	F	86	Prolapsus Recti.	Free	5	"	2 min	2 min	5 min	6 min	8 min	70 min	Iliac crests	31	No	P.accelerated at first but soon dropped to normal.	None	"	None	Perfect analgesia	Thought it a wonderful invention. Would not consent to a general anaesthetic.
32	Young adult	M	30	Piles & Fissure	Free	4	1 min	3 min	2½ min	5 min	7 min	9 min	45 min	Iliac crests	32	Slight	Slight nausea. 12 mins. after injection.	"	"	T99.4	Perfect analgesia	Very favourable.
33	Phthisical patient	M	40	Large horseshoe fistula.	Free	5	at once	4 min	3 min	4 min	8 min	10 min	55 min	1"below umbilicus.	33	No	Quite comfortable. P.& R. normal.	Slight headache.	"	T99.8	Analgesia perfect	Preferred it to CHCl3.
34	Healthy adult	M	43	Piles	Single drops	4	"	2 min	2½ min	4 min	7 min	11 min	48 min	Iliac crests	34	"	Slight pallor. 10 mins. after injection.	Slight headache.	"	None	"	Felt very comfortable.
35	Old man with atheromatous vessels	M	64	Prostatectomy	Free	5	2 min	4 min	3 min	5 min	6 min	8 min	60 min	Ensiform cartilage.	35	"	Faintness & nausea 10 mins. after injection. Relieved by brandy 3 p.	None	"	T99.6	"	Felt very fit after initial faintness.
36	House maid	F	24	Large Double Prepatellar bursa.	Free	5	at once	3 min	3½ min	4 min	6 min	7 min	65 min	Ensiform Cartilage	36	"	Slight nausea 10 mins. after injection.	Some incontinence of urine. 24 hours later. Lasted 1 day. Aching pain in legs.	"	T99.4	"	Felt rather nervous at first. Comfortable afterwards.

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37	Healthy adult	M	26	Varicose Veins	Free	5	1 min	2 min	4 min	3 min	7 min	9 min	48 min	2" above umbilicus.	37	No	Very comfortable.	Headache 3 days. Relieved by asperin	None	T99	Head accidentally lowered on removal to ward. analgesia splendid	Very satisfactory.
38	Distended woman with 3 days intestinal obstruction.	F	55	Right sided colotomy. (ascending colon.)	Free	5	at once	2 min	4 min	5 min	8 min	10 min	65 min	8th rib in mammary line.	38	No	Respiration embarrassed at commencement of operation. Pulse feeble. Adrenalin mXX administered.	Incontinence 24 hours later. Lasted 2 days.	None	T100	Very difficult. Puncture marked scholiosis.	Very satisfactory, says she felt frightened at first.
39	Healthy aduly	M	42	Inguinal Hernia	Free	5	1 min	3 min	2 min	4 min	7 min	10 min	50 min	2" above umbilicus	39	No	Very comfortable. Chatted whole time.	None	"	T99.4	Wound absolutely at end of operation. Superficial vessels not ligatured. Bled later when analgesia passed off.	Preferred it to CHCl3 which had for Hernia an opposite side.
40	Healthy woman.	F	43	Varicose Veins.	Single drops	5	2 min	4 min	3 min	6 min	8 min	10 min	30 min	Iliac crests	40	Slightly	Some nausea 12 mins. after injection.	Pain in legs. Rather severe for two days.			Analgesia passed off rapidly. Beginning to feel pain before end of operation.	Didn't like it. Would not consent to 2nd injection for this leg.
41	Plethoric old man	M	68	Varicose Veins (both legs)	Free	5	1 min	3 min	3 min	4½ min	6 min	7 min	60 min	2"above umbilicus.	41	No	Very comfortable P. & R. normal.	None	None	None	Analgesia perfect. Given at own request.	Very pleased he had Stovaine.
42	Same as 38	F	55	Enterectomy & end to end anastomosis.	Free	5	1 min	2 min	5 min	6 min	7 min	12 min	55 min	Ensiform cartilage.	42	"	Some nausea & sweating at commencement. Relieved by brandy 3 p.	None. No incontinence this time.	"	T99.6	Analgesia perfect. Felt some dragging on omentum.	Asked for stovaine again.
43	Healthy farmer.	M	65	Left strangulated Inguinal Hernia. (Large intestine only.)	Free	5	at once	3 min	4 min	4 min	6 min	8 min	58 min	Ensiform cartilage.	43	"	Perfectly comfortable.	None	"	None	Analgesia perfect. Bowels opened on table.	Very pleased with it. Felt no pain at all.
44	Nervous young woman.	F	18	Appendicectomy	Single drops	5	1 min	2 min	5 min	3 min	7 min	10 min	45 min	Ensiform cartilage.	44	"	P.120 at commencement of operation. Vomited slightly 12 mins. after injection.	None	"	T99.8	Analgesia perfect.	Says she felt frightened at first. But afterwards didn't mind it.

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45	Nervous Woman thin.	F	43	For. Diastema Rectorum.	Free	5 at once	1 min	3 min	5 min	6 min	10 min		Up to nipples 6th space.	45	No	Slight nausea no vomiting. Soon passed off.	Slight headache.	None	T99.	Analgesia perfect. The incision in this operation is from ensiform cartilage to Pubes.	Very satisfactory.
46	Feeble old man asthmatic	M	55	Colotomy. (Carcinoma recte.)	Free	4	1 min	1½ min	3 min	5 min	7 min	9 min	45 min	2" above umbilicus.	46	No	Excellent	None	None	none	Analgesia perfect.	Felt no pain whatever.
46	Neurotic woman.	F	31	Diastema Rectorum.	Free	5 at once	1½ min	3 min	6 min	7 min	10 min	70 min	Nipple line.	47	"	Slight nausea 15 mins. after injection. Rapidly passed off. Very talkative during operation.	Slight headache following day.	"	"	Analgesia perfect	Preferred it to ether. Felt very comfortable.
48	Healthy adult	M	48	Varicose Veins	Free	5	1 min	2 min	5 min	4 min	6 min	8 min	65 min	Ensiform cartilage.	48	"	Splendid.	Headache which lasted 3 days. Some aching in legs.	"	T99.8	Analgesia perfect. Patient is subject to migrains.	Thought it marvellous. Very satisfied.
49	Spare adult bronchitic.	M	35	Recurrent Inguinal Hernia	Very free	4 at once	2½ min	4 min	3½ min	7 min	9 min	40 min	2" above umbilicus	49	"	Excellent Felt slight dragging sensation once during operation. P. & R. normal.	Headache for 2 days. No cough.	"	None	Analgesia perfect	Has had both $CHCl_3$ & ether & on both occasions, suffered from chest. This time he said he felt like a king.
50	Healthy farmer	M	46	Large Inguinal Hernia.	Free	5 at once	1½ min	3 min	5 min	6 min	8 min	55 min	Ensiform cartilage.	50	"	Epigastric pain. 15 mins. after injection. Perspired freely. P dropped to 48. from 80. Later rose to 76 at end of operation.	None	"	T100.4	Analgesia perfect. Rather a nervous patient.	Had $CHCl_3$ 4 years ago. Liked stovaine much better.
51	Young man. Very ill with intestinal obstruction 3 days.	M	30	Resection of 45" of small intestine & lateral anastomosis.	Free	6 at once	1 min	2½ min	4 min	5 min	7 min	90 min	Nipple line	51	"	Foccal vomit. 5 times. P. rose from 80 to 112. Very comfortable.	None	"	"	Analgesia perfect. Passed flatus same night. No distension.	Said he felt no pain. Never had a general anaesthetic.

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52	Very old man with marked arterio-sclorosis. & gangrene of foot.	M	71	Amputation through lower 1/3 of thigh.	Free	5	1½ min	3 min	4 min	5 min	7 min	10 min	58 min	2" aboye umbilicus	52	No	Very comfortable P.irregular at commencement & fast 112. Fell to 80 R. 20.	None	None	None	Analgesia ve very good.	Felt no pain. Thought it marvellous. Would not consent to General anaesthetic.
53	Healthy young adult.	M	20	Varicose Veins.	Free	5	at once	1 min	3 min	3 min	4 min	7 min	60 min	Ensiform cartilage.	53	No	Very comfortable. P.80.R.16.	Very slight headache.	None	T100.2	Perfect analgesia	Stovaine at own request. Very satisfied with it.
54	Healthy young adult.	M	24	Removal of undescended testical.	Very free	5	at once	1 min	1½ min	2½ min	4 min	8 min	65 min	Ensiform cartilage.	54	No	Exceedingly comfortable. P.& R. normal.	None	None	Normal	Perfect analgesia	Thought it wonderful. Felt no pain whatever.
55	Healthy young adult	M	25	Removal of Dislocated int[l] semilunar cartilage.	Very free	5	at once	3 min	4 min	4½ min	6 min		50 min	Ensiform cartilage.	55	No	Very comfortable. No pain at all. P. & R. normal.	None	None	T98.8	Analgesia perfect.	Very favourable. Stovaine at own request. Had CHCl3 some years ago & did not like it.
56	Very nervous adult	M	42	Inguinal Hernia	Very free	5	at once	2 min	3 min	5 min	7 min		60 min	Ensiform cartilage.	56	No	Nausea 10 mins after injection Vomited ½ hour after injection. P.86. R.18.	"	"	Normal	Analgesia good.	Liked it better than CHCl3. but did not feel al together comfortable.